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ENDEMISM IN INDIAN GRASSES—TRIBE ANDROPOGONEAE

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ABSTRACT

The paper deals with endemism in the grass tribe Andropogoneae in India. Out of about 1150 species of grasses occurring in India, 350 species belong to Andropogoneae.

An analysis of the floras of regions adjacent to India shows that out of 329 species of Andropogoneae 151 are endemic to India, giving a percentage of 45.89. Out of these endemic species of Andropogoneae, 102 are confined to Peninsular India, 16 to Northeastern India, 12 to North-western Himalayas, 10 to Upper Gangetic Plain, 8 to the Indus Plain and North-western India and 3 to rest of the country.

Species which extend beyond the boundaries of India show affinity primarily with Africa. Studies on endemism are important for conservation of rare taxa.

The word endemic is antonym of epidemic. In botanical literature, it refers to naturally growing taxa (species, genus or family) confined to a particular region. This region may be a spot of few square kilometers, a district/county or country or even a phytogeographical botanical region comprising more than one country. But, it is not conventional to express endemics for areas larger than a country.

India has a rich flora, and is therefore, a region of particular interest to taxonomists and plant-geographers. Having, in the north, the highest elevations of the world (in the vicinity of Mt. Everest), and in south, a long coast-line along the peninsular region protruding into the ocean, added with the blending of its western boundaries into the arid region, provides to India a variety of habitat conditions. The climate of India is also remarkable. The wide range of rainfall from the almost rainless dry regions of Rajasthan to the rainiest spot on the earth (namely Mausingram in eastern India) and of temperatures from some of the hottest places in Rajasthan to the perpetual snow-covered peaks in the Himalayas provide uniqueness to the climate of India.

Changes in political boundaries have tended to obscure some of the features of the flora of this region, as Tibet, Nepal, Bhutan, Burma, Bangla Desh, Malaya Peninsula, Sri Lanka and Pakistan are now excluded from the earlier jurisdiction of Indian sub-continent. Also, due to the rapid increase in population, industrial and other technological developments and consequent intense biotic interference, much of the vegetation and flora of the region have been disturbed.

There has been a revival of interest in the floristic studies in India during last twenty five years, and much exploration work has been done in different parts of of the country. Some local floras have been published and many new taxa have been added. There are still many areas which are botanically unexplored or under-explored.

Very little work (Chatterjee, 1940, 1962; Jain, 1967; Rao, 1974; Rao, 1972, 1979; Rau, 1974; Subramanyam & Nayar, 1974; Rao, 1978; Mahabale, 1979), has been published on the phytogeography of India,

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Grasses have often been neglected even in the floristic studies e.g., Duthie, who was himself primarily an agrostologist did not complete the part dealing with the grasses in the Flora of Upper Gangetic Plain—(Duthie 1903-20). Similarly, Kanjilal et al. (1934-40) completed all but the volume dealing with the grasses of Assam, which was later completed by Bor (1940). Even many floristic lists or enumerations exclude or scantly deal with the grasses. This is sometimes due to the notion that the grasses are difficult to identify. Also, being usually the last family (Serial number 200 in Bentham and Hooker's classification 1862-1883) i.e., in the end of the treatment of most floristic works, perhaps the resources or the enthusiasm dwindle by the time authors reach the material of this family.

Since the work of Hooker (1897) on Gramineae, no such type of work is available. However, Bor's book on the "Grasses of Burma, Ceylon, India and Pakistan", published in 1960 is the only concise and consolidated account of the Indian species and varieties of the grasses. Hence, an attempt is being made to study the phytogeography and endemism in the family Poaceae in India The present work deals with authors' observations on one of the larger tribes of the family, namely, the tribe Andropogoneae.

Tribe: ANDROPOGONEAE

Andropogoneae is one of the largest tribes of grasses, having about 90 genera and 850* species (Pilger 1940; Potzal 1956); it is widely distributed in the world. Bor (1960) dealt with 62 genera and 322 species from within the present boundaries of India. Subsequently, Ved Prakash et al. (1978) have published additions to Bor's work, and the total number now is estimated to be 67 genera and 350 species, which gives a percentage of nearly 30.4 of the total Indian grass flora.

The distribution of plants is a dynamic phenomenon and is the result of the total impact of migration or movement of the floras, including both the gains and losses in the entire phytogeographical area. Members of this tribe occur mostly in the warmer regions of both the hemispheres and are poorly represented in the cold temperate regions. They are absent in the arctic and alpine regions.

The general distribution of Andropogoneae in India and certain adjacent regions is shown in fig. 1. It is based on the data from several floras, floristic lists and available herbarium materials. Percentage of species of Andropogoneae to the total grass flora has been calculated and lines have been drawn on the map to show the regions where the percentage is 20-30 and > 50. The area of high concentration of Andropogoneae in India lies in the peninsular region.

For analysing the endemism, several floras and floristic lists of India and adjacent regions have been consulted. As taxonomic status of species, such as merging or splitting are known to affect the range of distribution, as far as possible, the nomenclature and distribution of species were updated.

For deciding endemism, the present political boundaries of India have been considered. Due to inaccessibility of recent literature on far away regions, it has been possible to include only some adjacent regions such as Pakistan, Nepal, Bhutan, Burma, Bangla Desh and Sri Lanka for study and comparison.

In addition to the endemic taxa strictly confined to India, there are some which occur in India but extend to one or more of the neighbouring countries such as Pakistan, Tibet, Nepal, Bhutan, Burma, Bangla Desh or Sri Lanka; these are not treated here as strictly endemic. Cultivated and introduced taxa and the hybrids are excluded from consideration.

The number of endemic species within

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*The present number will be well over one thousand.

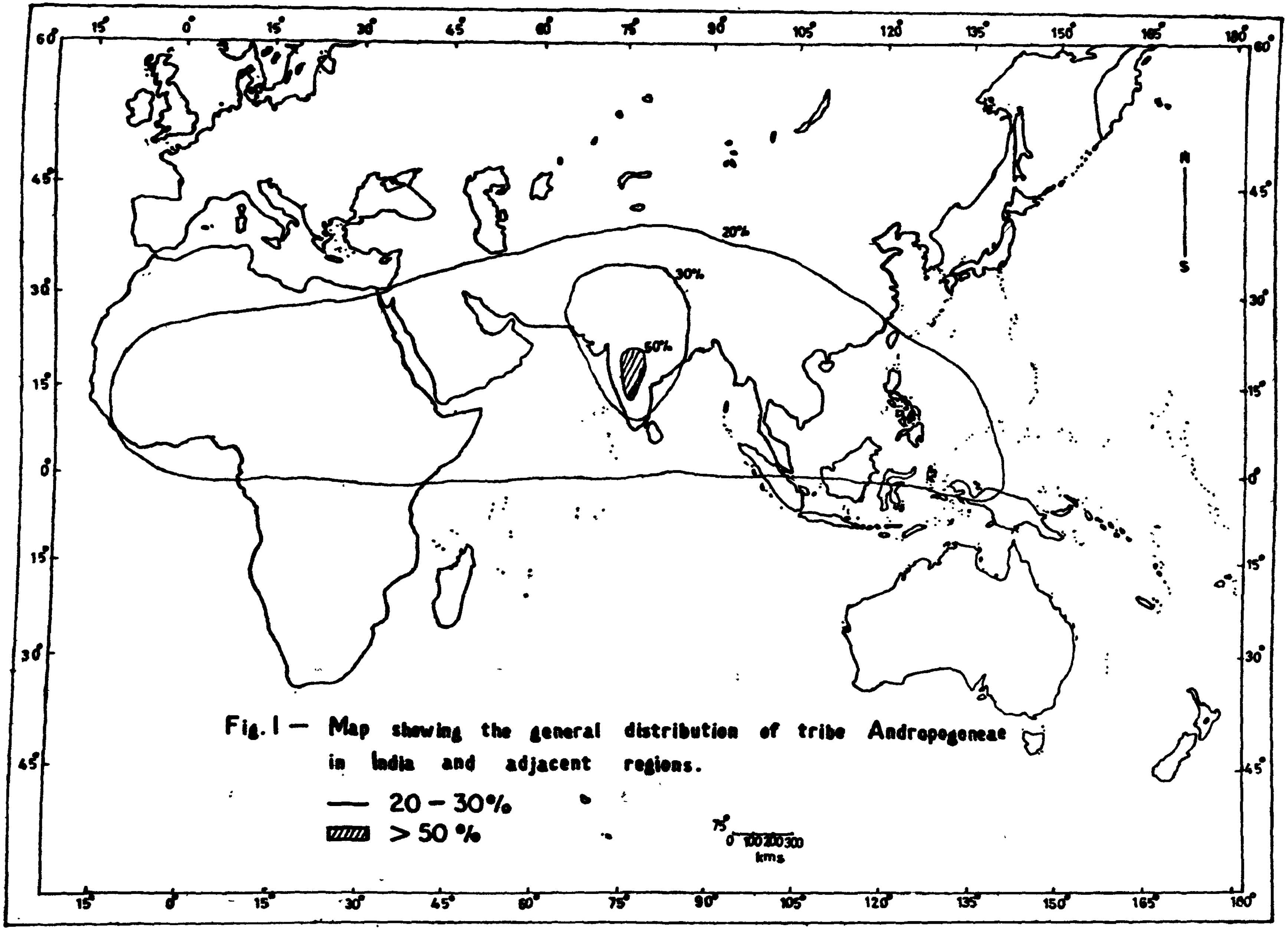

Fig. 1 — Map showing the general distribution of tribe Andropogoneae in India and adjacent regions.

Table 1: Total number of species in each genus and total number of wides and endemics in India and adjacent regions.

Sl. no.	Name of Genera	Total* no. of spp. in the World	Total no. of spp. in present India	Endemic to India	Endemic to adjacent region	Endemic to India & adjacent region	Wides	Hybrids introduced & cultivated	Total no. of Col. 5, 7 & 8
1	2	3	4	5	6	7	8	9	10
1.	Andropogon L.	113	8	2	1	3	1	2	6
2.	Apluda L.	1	1	—	—	—	1	—	1
3.	Apocopis Nees	11	5	1	5	2	2	—	5
4.	Arthraxon P. Beauv.	30	25	15	—	—	10	—	25
5.	Bhidea Bor	1	1	1	—	—	—	—	1
6.	Bothriochloa O. Ktze	20	17	10	1	1	6	—	17
7.	Capillipedium Stapf	10	8	6	—	—	2	—	8
8.	Chrysopogon Trin.	25	15	7	1	1	7	—	15
9.	Cleistachne Benth.	4	2	1	—	—	1	—	2
10.	Coelorhachis Brongn.	12	2	—	1	1	1	—	2
11.	Cymbopogon Spreng.	60	25	7	4	5	11	2	23
12.	Dichanthium Willemet	15	8	5	1	—	3	—	8
13.	Diectomis Kunth	1	1	—	—	—	1	—	1
14.	Dimeria R. Br.	40	20	13	4	4	3	—	20
15.	Eccoilopus Steud.	4	1	—	—	—	1	—	1
16.	Elyonurus Humb. et Bonpl. ex Willd.	50	1	—	—	—	1	—	1
17.	Eremochloa Buse	8	1	—	1	—	1	—	1
18.	Eremopogon (Hack.) Stapf	4	2	1	—	—	1	—	2
19.	Eriochrysis P. Beauv.	8	1	1	—	—	—	—	1
20.	Euclasta Franch.	1	1	—	—	—	1	—	1
21.	Eulalia Kunth	30	14	2	2	6	6	—	14
22.	Eulaliopsis Honda	2	2	1	1	—	1	—	2
23.	Germainia Balans.	3	1	—	1	1	—	—	1
24.	Hackelochloa O. Ktze.	2	2	—	—	—	2	—	2
25.	Hemarthria R. Br.	10	4	1	—	—	3	—	4
26.	Hemisorghum C. E. Hubb.	1	1	1	—	—	—	—	1
27.	Heteropholis C. E. Hubb.	2	—	—	1	—	—	—	—
28.	Heteropogon Pers.	12	6	3	—	—	3	—	6
29.	Hyparrhenia Anderss	75	6	1	—	—	4	1	5

1	2	3	4	5	6	7	8	9	10
30.	Imperata Cyr.	10	2	—	—	—	2	—	2
31.	Indochloa Bor	2	2	2	—	—	—	—	2
32.	Ischaemum L.	50	34	24	3	3	7	—	34
33.	Ischnochloa Hook. f.	1	1	1	—	—	—	—	1
34.	Iseilema Anderss.	20	7	4	—	2	1	—	7
35.	Lasiurus Boiss.	3	2	1	1	—	1	—	2
36.	Lophopogon Hack.	3	3	3	—	—	—	—	3
37.	Manisuris L.	28	10	10	—	—	—	—	10
38.	Microstegium Nees	30	5	—	3	1	4	—	5
39.	Miscanthus Anderss.	20	4	1	—	2	1	—	4
40.	Mnesithea Kunth	5	1	—	—	—	1	—	1
41.	Narenga Bor	2	2	—	—	—	2	—	2
42.	Ophiurus Gaertn. f.	7	3	1	—	—	2	—	3
43.	Parahyparrhenia A. Camus	4	1	1	—	—	—	—	1
44.	Phacelurus Griseb.	4	1	—	—	—	1	—	1
45.	Pogonachne Bor	1	1	1	—	—	—	—	1
46.	Pogonatherum P. Beauv.	4	4	2	—	—	2	—	4
47.	Polytrias Hack.	1	1	—	—	—	1	—	1
48.	Pseudanthistiria (Hack.) Hook. f.	4	4	3	—	1	—	—	4
49.	Pseudodichanthium Bor	1	1	1	—	—	—	—	1
50.	Pseudopogonatherum A. Camus	2	1	—	—	—	1	—	1
51.	Pseudosorghum A. Camus	1	1	—	—	—	1	—	1
52.	Ratzeburgia Kunth	1	—	—	1	—	—	—	—
53.	Rottboellia L. f.	4	2	1	—	—	1	—	2
54.	Saccharum L.	15	12	—	2	1	10	1	11
55.	Schizachyrium Nees	50	5	1	—	2	2	—	5
56.	Sclerostachya (Anderss.) A. Camus	3	2	1	—	—	1	—	2
57.	Sehima Forssk.	7	4	2	—	—	2	—	4
58.	Sorghastrum Nash	12	1	—	—	—	—	1	—
59..	Sorghum Moench	60	23	3	—	—	8	12	11
60.	Spodiopogon Trin.	10	3	2	—	—	1	—	3

1	2	3	4	5	6	7	8	9	10
61.	Thaumastochloa C. E. Hubb.	10	1	—	—	—	1	—	1
62.	Thelepogon Roth ex Roem. et Sch.	1	1	—	—	—	1	—	1
63.	Themeda Forssk.	10	19	6	—	3	8	2	17
64.	Thyrsia Stapf.	3	1	—	—	—	1	—	1
65.	Triplopogon Bor	1	1	1	—	—	—	—	1
66.	Vetiveria Lem-Lisanc.	10	2	1	—	—	1	—	2
67.	Vossia Wall. et Griff.	1	1	—	—	—	1	—	1
	Total :	971	350	151	34	39	139	21	329

*The number of world species is taken chiefly from Willis (1973), but in some cases effort has been made update it.

each genus of Andropogoneae in India are tabulated in Table-1. The name of the genus is followed by the total number of species in world (Col. 3) and number of species in India (Col. 4). The number of species endemic to India and endemic to adjacent regions are given in Column 5 and 6 respectively. The number of species occurring in India and also in some adjacent countries, i.e. endemic to Indian sub-continent (they are not strictly endemic to political boundaries of India but to the phytogeographical regions of Indian subcontinent) is mentioned in Colmn 7. The number of widely distributed species is given in Column 8, and the number of cultivated, introduced and hybrid taxa is shown in Column 9. The number of naturally growing species under each genus i.e. the total of Columns 5, 7 and 8 is given in the last Column (Col. 10).

Analysis of endemism and phytogeography of the tribe Andropogoneae

In order to review the endemism and phytogeographical affinities within the tribe, an analysis was done on the basis of the works of Willis (1973), Santapau and Henry (1973) and Bor (1960).

The genera strictly endemic to India are *Bhidea* Bor, *Indochloa* Bor, *Ischnochloa* Hook. f., *Lophopogon* Hack., *Pogonachne* Bor, *Pseudodichanthium* Bor and *Triplopogon* Bor.

The above seven genera include ten species which are strictly endemic to peninsular India—a region already known to be rich in endemism.

Pseudanthistiria (Hack.) Hook. f. and *Ratzeburgia* Kunth are endemic to the region of Indian sub-continent. These two genera include five species and their distribution extends beyond the boundaries of India and into adjacent regions.

The number of endemic species of the tribe Andropogoneae in different regions of India and their percentage to total endemics is given in Table 2.

It is seen from this Table that 45.89 percent of the total species are stritcly endemic to India.

When we compare the occurrence of Andropogoneae in India with the neighbouring areas of the Indian sub-continent, the position becomes more complex. Takhtajan (1969) has recognised 37 phytogeographical regions in the world of which one is the Indian region. Four other regions namely,

Table 2. Distribution of Andropogoneae

Regions	Total number of endemic species	Percentage of total Andropogoneae (329 spp.)
A. Endemic to India as a whole	151	45.89
(i) Endemic to Peninsular India	102	31.00
(ii) Endemic to far Northeast India	11	3.34
(iii) Endemic to Eastern Himalaya	5	1.51
(iv) Endemic to Northwest Himalaya	12	3.64
(v) Endemic to Upper Gangetic Plain	10	3.03
(vi) Endemic to Indus Plain	8	2.43
(vii) Endemic to rest of India	3	0.91
B. Endemic to Indian sub-continent	39	11.85
C. Wides	139	42.24
(i) Common to India and Africa among the wides	52	15.80

(1) *Sino-Japanese region*, (2) *Indo-Chinese region*, (3) *Irano-Turanian region* and (4) *Saharo-Sindian region*, also have some floristic elements common with India. Such elements are represented in India by several genera and species. Eastern and Central Himalayas, including the Assam region, have several Sino-Japanese and Indo-Chinese elements e.g., species of *Capillipedium* Stapf, *Eccoilopus* Steud., *Hackelochloa* O. Ktze., *Saccharum* L., *Sclerostachya* (Anders.) A. Camus and *Spodiopogon* Trin. The larger part of India is considered phytogeographically as the Indian region. It includes Malabar, Deccan and some parts of Central India. This region shows high concentration of species of Andropogoneae. Many of them are endemic to India, e.g., *Arthraxon junnarensis* Jain et Hemadri, *A. raizadae* Jain, Hemadri et Deshpande, *A. santapauii* Bor, *Dimeria woodrowii* Stapf, *Eremopogon tuberculatus* (Hack.) A. Camus, *Lophopogon duthiei* Stapf ex Bor, *L. kingii* Hook. f., *Pogonachne racemosa* Bor, *Triplopogon ramosissimus* (Hack.) Bor.

Some floral elements of Irano-Turanian and Saharo-Sindian region occur in Indus Plain and Northwest India. Some species of *Bothriochloa* O. Ktze., *Chrysopogon* Trin., *Imperata* Cyr., *Schizachyrium* Nees, *Saccharum* L., etc. are common in Indian as well as in Irano-Turanian region. The occurrence of some species of *Arthraxon* P. Beauv., *Chrysopogon* Trin., *Imperata* Cyr., *Lasiurus* Boiss., *Saccharum* L. etc. shows affinities with Saharo-Sindian region.

DISCUSSION

The indigenous flora of India comprises species which have arisen here and those which have arrived here at different times from different sources.

The study of the tribe Andropogoneae reveals occurrence of a large number of wide species e.g., *Arthraxon micans* (Nees) Hochst., *Bothriochloa caucasica* (Trin.) Hubb., *B. insculpta* (Hochst.) A. Camus, *Chrysopogon echinulatus* (Nees) Wats., *C. gryllus* (L.) Trin., *Cymbopogon nervatus* (Hochst.) Chiov., *Elyonurus royleanus* Nees ex Rich. in North western region, suggesting that elements of tropical and temperate floras of Northern hemisphere have migrated to the North western region of India.

45.89 percent of the total Indian Andropogoneae are endemic to India. It clearly indicates the uniqueness of the Indian flora. In India there are three areas containing specially large number of endemic species; these jointly contribute to the high percentage for the whole country. These areas are—(1) Peninsular India, (2) the Himalayas and (3) Far Northeastern India.

Turrill (1964), stated that "The peninsular regions are a close second to islands in having favourable conditions for endemism". Analysis of endemism in the tribe Andropogoneae amply supports Turrill's view.

Fig. 1 also shows that more than 50% of the total species of Andropogoneae occurring in India are found in Peninsular India, which is higher than any other phytogeographical region of India.

Further, out of the 139 wide species, 52 species occur in India and Africa, indicating phytogeographical affinity between the floras of Africa and India.

The flora of India and more so the grasses, need intensive studies in field and herbarium to bring out more novelties. New discoveries of taxa add to the richness of endemism and uniqueness of flora, and there seems no doubt that with increasing knowledge of our flora the picture of endemism will also change. Many of the endemics are very rare and threatened; some are near extinction. It is hoped that better knowledge of endemic taxa will create awareness for their conservation.

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